



A.D. 1854 N^o 940.

SPECIFICATION

OF

THOMAS WEATHERBURN DODDS.

FURNACES AND FIRE-PLACES.

LONDON:

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1854.



A.D. 1854 N° 940.

Furnaces and Fire-places.

LETTERS PATENT to Thomas Weatherburn Dodds, of the Holmes Engine and Railway Works, Rotherham, in the County of York, Engineer, for the Invention of “**IMPROVEMENTS IN FURNACES AND FIRE-PLACES, FOR EFFECTING A MORE PERFECT COMBUSTION OF FUEL AND PREVENTION OF SMOKE.**”

Sealed the 20th June 1854, and dated the 24th April 1854.

PROVISIONAL SPECIFICATION left by the said Thomas Weatherburn Dodds at the Office of the Commissioners of Patents, with his Petition, on the 24th April 1854.

I, THOMAS WEATHERBURN DODDS, of the Holmes Engine and Railway
5 Works, Rotherham, in the County of York, Engineer, do hereby declare the nature of the said Invention for “**IMPROVEMENTS IN FURNACES AND FIRE-PLACES, FOR EFFECTING A MORE PERFECT COMBUSTION OF FUEL AND PREVENTION OF SMOKE,**” to be as follows :—

This Invention relates to a peculiar construction of furnace or fire-place for
10 steam boilers or other purposes, whereby a more perfect combustion of fuel with the prevention of smoke is effected, and consists in the employment of a series of hollow bars, through which the water of the boiler (when the furnace is applied to a steam generator or water heater) is allowed to circulate. The smoke or bituminous vapour of the green fuel is caused to pass through the
15 fuel that has been previously coked, and which is pushed forward on to the auxiliary bars, herein-before described. Or a separate door may be employed for feeding the auxiliary bars with coke. By this means the coked fuel takes up, for the supporting of its combustion, the smoke and unconsumed gases evolved from the newly supplied fuel, at the same time that a certain amount
20 of atmospheric air is admitted at the front, sides, top, through or behind the

Dodds' Improvements in Furnaces and Fire-places, &c.

bridge of the furnace. The "auxiliary" bars may be connected to boilers or steam generators of any shape and form, and may either constitute a portion of the boiler, being attached thereto, or may be simply for heating water or for feeding. The furnace above described is applicable also to puddling furnaces and reverberatory furnaces, and to the heating of water for warming 5 buildings, conservatories, &c., and may be modified to suit almost any position, whether for land or marine boilers, or for locomotive engine boilers. The auxiliary bars may be laid either level, at an angle, or vertical; if the latter, the fuel may be placed between two sets of bars, the furnace being fed from above. In locomotive engine boilers the principles herein-before described may 10 be carried out by placing a furnace at each end of the boiler. In the front or smoke box furnace it is proposed to burn coal, the smoke and unconsumed gases passing along an internal flue or flues running part of or the entire length of the barrel of the boiler, and opening into the ash pit of the second furnace, the "auxiliary" bars of which are made hollow, with the water of the boiler 15 circulating through them. The fuel employed in this furnace is coke, and the smoke and unconsumed gases from the coal furnace pass through the burning coke, and become consumed thereby. A second flue or series of flues conducts the heat back again along the barrel of the boiler into the smoke box. By another arrangement the two furnaces may be contained in one fire box, the 20 auxiliary bars, supplied with coke from a separate door, being placed above the bars containing the coal, so that the whole of the products of combustion of the coal must pass through the burning coke. A third arrangement consists in placing the auxiliary bars at an angle, with one end resting in a water space division piece, running transversely across the fire box. This division piece 25 serves to direct the products of combustion from the coals burnt in the lower grate down through the auxiliary bars, and burning coke into the flue or flues of the boiler, which are situated beneath them. In order to keep up the circulation in the auxiliary bars, a water pipe or pipes may be employed, in some cases, connected with another portion of the boiler. In puddling or other 30 furnaces, when applicable, air passages through vessels containing water may be employed for heating the air to feed the furnace above the bars, by allowing a natural current of air to pass through them. Auxiliary bars may be used in all furnaces, whether for engines, puddling reverberatory furnaces, or otherwise. By another arrangement, a coke oven, ovens, or retorts may be employed 35 for the purposes of partially coking the coal before being pushed forward on to the bars; (during the coking the bituminous vapour passes over the bars,) and is taken up in combustion by the better coked part of the same; recesses are made for heating the air before it is admitted into the furnace.

Dodds' Improvements in Furnaces and Fire-places, &c.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Thomas Weatherburn Dodds in the Great Seal Patent Office on the 24th October 1854.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, THOMAS WEATHERBURN DODDS, of the Holmes Engine and Railway Works, Rotherham, in the County of York, Engineer, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-fourth day of April, in the year of our Lord One thousand eight hundred and fifty-four, in the seventeenth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Thomas Weatherburn Dodds, Her special license that I, the said Thomas Weatherburn Dodds, my executors, administrators, and assigns, or such others as I, the said Thomas Weatherburn Dodds, my executors, administrators, or assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for “**IMPROVEMENTS IN FURNACES AND FIRE-PLACES, FOR EFFECTING A MORE PERFECT COMBUSTION OF FUEL AND PREVENTION OF SMOKE,**” upon the condition (amongst others) that I, the said Thomas Weatherburn Dodds, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Thomas Weatherburn Dodds, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the accompanying Drawings, and to the letters and figures marked thereon, that is to say:—

My said Invention relates to a peculiar construction of furnace or fire-place for steam boilers or other purposes, whereby a more perfect combustion of fuel with the prevention of smoke is effected, and consists in the employment of a series of hollow auxiliary bars, through which the water of the boiler, when the furnace is applied to a steam generator or water heater, is allowed to circulate. The smoke or bituminous vapour of the green fuel is caused to pass through the fuel that has been previously coked, and which is pushed forward on to the auxiliary bars herein-before described; or a separate door may

Dodds' Improvements in Furnaces and Fire-places, &c.

be employed for feeding the auxiliary bars with coke. By this means the coked fuel takes up, for the supporting of its combustion, the smoke and unconsumed gases evolved from the newly supplied fuel, at the same time that a certain amount of atmospheric air is admitted at the front, sides, and top, and through or behind the bridge of the furnace. The “auxiliary” bars or furnace may be 5 connected to boilers or steam generators of any shape and form, and may either constitute a portion of the boiler, being attached thereto, or may be simply for heating water or for feeding. The furnace above described is applicable also to puddling furnaces and reverberatory furnaces, and to the heating of water for warming buildings, conservatories, &c., and may be modified to suit almost 10 any position, whether for land or marine boilers, or for locomotive engine boilers; the auxiliary bars may be laid either level, at an angle, or vertical. In locomotive engine boilers the principles herein-before described may be carried out by placing a furnace at each end of the boiler. In the front or smoke box furnace it is proposed to burn coal, the smoke and unconsumed gases 15 passing along an internal flue or flues running part of or the entire length of the barrel of the boiler, and opening into the ash pit of the second furnace, the “auxiliary” bars of which are made hollow, with the water of the boiler circulating through them. The fuel employed in this furnace is coke, and the smoke & unconsumed gases from the coal furnace pass through the burning coke, and 20 become consumed thereby; a second flue or series of flues conducts the heat back again along the barrel of the boiler into the smoke box. By another arrangement the two furnaces may be contained in one fire box, the auxiliary bars, supplied with coke from a separate door, being placed above the bars containing the coal, so that the whole of the products of combustion of the coal 25 must pass through the burning coke. A third arrangement consists in placing the auxiliary bars at an angle, with one end resting in a water space division piece running transversely across the fire box. This division piece serves to direct the products of combustion from the coals burnt in the lower grate down through the auxiliary bars, and burning coke into the flue or flues of the boiler, 30 which are situated beneath them. In order to keep up the circulation in the auxiliary bars, a water pipe or water pipes may be employed in some cases, connected with another portion of the boiler. In these last-described arrangements only one set of bars are directly open to the atmosphere, the water bars not being open to the atmosphere. In puddling or other furnaces, when 35 applicable, air passages through vessels containing water may be employed for heating the air to feed the furnace above the bars, by allowing a natural current of air to pass through them. Auxiliary bars may be used in all furnaces, whether for engines, puddling, reverberatory furnaces, or otherwise.

Dodds' Improvements in Furnaces and Fire-places, &c.

By another arrangement, a coke oven, ovens, or retorts may be employed for the purposes of partially coking the coal before being pushed forward on to the bars; during the coking, the bituminous vapour passes over the bars, and is taken up in combustion by the better coked part of the same; recesses
5 are made for heating the air before it is admitted into the furnace.

And in order that my said Invention may be more readily understood, I shall now proceed to describe the several Figures on the Sheets of Drawings hereunto annexed.

Fig. 1 on Sheet 1 of my Drawings represents an end or front elevation of
10 a cylindrical boiler with internal flue, with the fire door removed, fitted with my apparatus for effecting a more perfect combustion of fuel and prevention of smoke; and Fig. 2 on the same Sheet of Drawings is a corresponding longitudinal vertical section of the same, taken through the centre line of the boiler. The ordinary fire bars A are supported at their inner ends by the
15 transverse water space B, which communicates with the interior of the boiler by the lateral passages C, C. Into the back of this water space are fitted a series of hollow water bars D, D, which I term "auxiliary" bars."

This second grate, formed by the auxiliary bars, is not open directly to the atmosphere however, the first grate alone being supplied with atmospheric
20 air direct. The "auxiliary" bars are placed at a slight angle from a horizontal line, and are screwed at their upper ends into another water space E, which opens into the boiler through the top of the fire box, as shewn more clearly at Fig. 2. By this arrangement, it will be obvious that a constant circulation of water will take place through the "auxiliary" bars, thereby materially
25 expediting the generation of steam.

The two ash pits F and G are separated by a partition, which is fitted with a hinged door H; for the purpose of regulating the supply of air to the inner ash pit, and to facilitate the cleaning or removal of the ashes from the same, a number of air passages I are formed in the brickwork over the mouth of the
30 furnace, and the air for supplying the same enters, as shewn by the arrows, through apertures in the furnace door, and passes through the passages I into the furnace itself above the burning fuel on the front and auxiliary bars of the grate. The fuel on the "auxiliary" bars has first been coked or baked on the ordinary bars near the mouth of the furnace, and afterwards, when suffi-
35 ciently coked, it is pushed forward on to the inclined "auxiliary" bars to make room for fresh green fuel to be supplied to the front portion of the grate. As the entrances to the flues J are situated in the second ash pit beneath the auxiliary bars, it follows, as a matter of course, that the whole of the smoke and unconsumed gases evolved from the green fuel in the front portion of the

Dodds' Improvements in Furnaces and Fire-places, &c.

grate must of necessity pass over and through the incandescent mass on the “auxiliary” bars, and become thereby thoroughly consumed before entering the flues J of the boiler. For facilitating the cleaning of the water bars, the front of the water space B is made to take off, by which means facility is also afforded for repairing or removing any of the water bars in case of fracture. Fig. 3 5 on the same Sheet of Drawings represents a plan and horizontal section of the furnace of a cylindrical boiler with external flues, fitted with coking ovens or retorts, for coking the green fuel before entering the furnace; Fig. 4 is a vertical longitudinal section of the furnace; and Fig. 5 is a front elevation of the same, with the furnace doors removed from one side to shew the interior 10 of one of the coking ovens and furnace. On each side of the principal entrance A to the furnace are formed two coking ovens B, B, made of fire clay, fire stone, or other fire-resisting material, which open into the front end of the furnace C at the sides. These ovens are filled with fresh or green fuel through the hoppers C¹, fitted with sliding doors and inverted funnel-mouthed 15 passage C¹¹; this fuel is allowed to coke or bake previously to being pushed forward into the incandescent fuel in the body of the furnace. A plentiful supply of air is admitted by the apertures D, D, situated in the sides of the coking ovens over the fire-place and through the bridge E. This bridge is constructed to give a large heating surface to the air passages, which may be 20 made zig-zag in plan, as shewn in the detail, Fig. 6; or they may be made alternately in the header and stretcher courses of the brickwork, as shewn in the detail, Fig. 7. A second bridge F is situated a short distance behind the first bridge, by which means the heat is more confined, and consequently more economised, than when passing direct along the flues to the chimney. 25 The space between the bridges forms also a combustion chamber, wherein the smoke and unconsumed gases are ignited and consumed.

Fig. 1 on Sheet 2 of my Drawings represents a front or end elevation and half transverse section of an engine boiler with internal flues, shewing the application of fire brick, fire stone, or fire clay to the dead plate and arch 30 thereof, for the purpose of ensuring a better coking medium for the freshly supplied fuel before being pushed forward into the grate bars. Fig. 2 is a corresponding longitudinal section of the same, shewing also the mode of admitting a current or currents of heated air between the brickwork of the bridge and the casting which supports the same; and Fig. 3 is a plan of the 35 boiler, with a portion broken away to shew the internal arrangement of the furnace. The improvements in this boiler consist in the application of a covering A of fire brick or fire clay to the dead plate and arch, for the purpose of facilitating the coking of the fuel contained thereon, by affording a

Dodds' Improvements in Furnaces and Fire-places, &c.

better coking medium. Another improvement in this boiler consists in the formation of air passages between the brickwork B of the bridge and the casting C, such air passage or passages being supplied with hot air from the ash pit D direct into which they open, close under the furnace bars E.

5 The furnace bars are arranged alternately in couples or pairs, two up and two down, at the bridge, as shewn in the Drawing, for the purpose of varying the thickness of the fire; a small door F is fitted at the back of the ash pit, to enable any dust or ashes carried over the bridge into the combustion chamber G to be removed therefrom.

10 Fig. 1 on Sheet 3 of my Drawings represents a longitudinal vertical section of a locomotive boiler fitted with my improved apparatus, whereby coal may be employed also as fuel in place of coke alone. Transversely across the fire box is an inclined water space A, which rises up from the lower portion of the back of the fire box to within a short distance of the front of
15 the same, a small space B being left to allow the smoke and gases evolved from the coal in the grate C to pass into the upper portion of the fire box, and be brought in direct contact with the incandescent coke on the auxiliary water bars D. These bars, which are not open to the atmosphere, are slightly inclined, and are fitted at their lower ends into the upper portion of the water
20 space A, whilst their upper ends are fitted in to the upper portion of the back of the fire box above the mouths of the tubes E, E. The auxiliary bars D are supplied with coke through the upper fire door F, and the lower grate is supplied with coal through the bottom fire door G. H is a door for the removal of the ashes from the ash pit I; J is the flame or combustion
25 chamber. Should it be found necessary to reduce the size of the combustion chamber, the top of the barrel of the boiler may be elongated and the chimney dropped through, as shewn by the dotted lines; any number of tubes or flues E may be employed, from one upwards. The smoke and gases arising from the coal fire ascend through the passage or opening B, and penetrate through
30 the incandescent coke on the "auxiliary" bars before entering the tubes of the boiler, and are consequently consumed or ignited before reaching the flame chamber end of the boiler. By the aid of the inclined water bars D, a constant circulation of boiling water and formation of globules of steam is kept up in the boiler, thereby tending to generate the steam more rapidly
35 than in the ordinary locomotive boilers. Fig. 2 on the same Sheet of Drawings represents a sectional plan of the seating of a brewing copper, shewing the arrangement of the flues and "auxiliary" water bars herein-before described. A are the ordinary fire bars, and B the "auxiliary" or water bars, which may be set at an angle, as herein-before described. These bars, as I

Dodds' Improvements in Furnaces and Fire-places, &c.

have before described, are not open to the atmosphere, but receive their supply of air from the first furnace A. The coal, having been well coked on the bars A, is pushed forward on to the “auxiliary” bars, and the smoke and gases thrown off from the partially consumed fuel on the bars A are made to penetrate through the incandescent fuel on the water bars before it can enter the flues. 5

On leaving the furnace, the flame and heated air returns along the outside of the same by the lateral return flues C, C, and then diverges right and left into the circular flues D, D, the two currents uniting again at the back of the furnace at E before entering the flue F, which leads direct to the chimney. The water bars are connected at their extremities with the pipes G, H, 10 communicating with the tank I at different levels; thus, a constant & continuous circulation of hot water goes on through the water bars and along the pipes G and H to the tank. In place of the ordinary fire bars A, a fire brick coking oven or ovens may be substituted, occupying the whole or a portion of the space at present taken up by the fire bars. In this oven the 15 fuel is coked, as herein-before described, and then pushed forward on to the “auxiliary” or water bars. Fig. 3 on the same Sheet of Drawings represents a longitudinal vertical section of a double-draught puddling furnace, with my smoke-preventing apparatus attached. The furnace A is supplied with coal through the feeding aperture B. A series of air holes C, C, are formed in the 20 sides of the furnace, to aid the combustion in the grate A. Immediately behind the bridge D are situated the inclined “auxiliary” water bars E, which are fitted at their extremities into the water pipes F and G. This auxiliary furnace is supplied with coke through the aperture H, and the smoke and gases from the fire grate A must of necessity pass through the incandescent fuel on 25 the auxiliary bars, and be there consumed before entering the main body I of the furnace. In place of the “auxiliary” furnace being composed of hollow water bars, it may be composed, as shewn at Figs. 4 and 5, of boiler plates A, and short tubes B, connecting the same, through which tubes the flame and gases is allowed to pass. These tubes may either be parallel or tapered, 30 and of any transverse section. Although two fires are shewn in the Drawing of the puddling furnace, yet the water bars may be used alone with the first or ordinary grate, if desired, or vice versa. I may here observe, that although I have in all cases where auxiliary bars are employed described the smoke and unconsumed gases as passing from the coal fire, through the incandescent 35 fuel on the second or auxiliary grate, yet I do not claim the absolute use of a coke fire in conjunction with a coal fire for the prevention of smoke; neither do I claim the use of two grates for that purpose, so long as both grates are open to the direct action of the atmosphere.

FIG. 1.

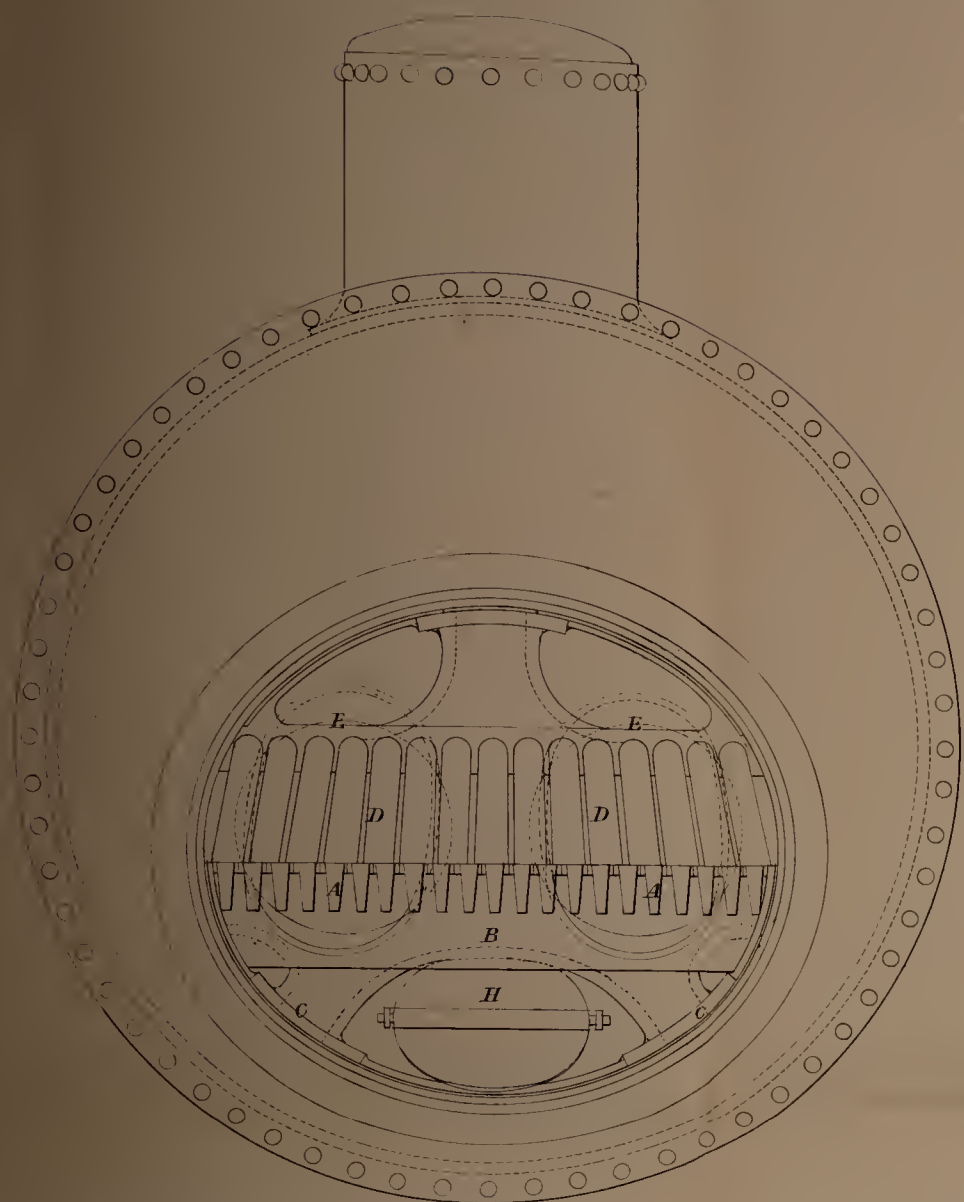


FIG. 2.

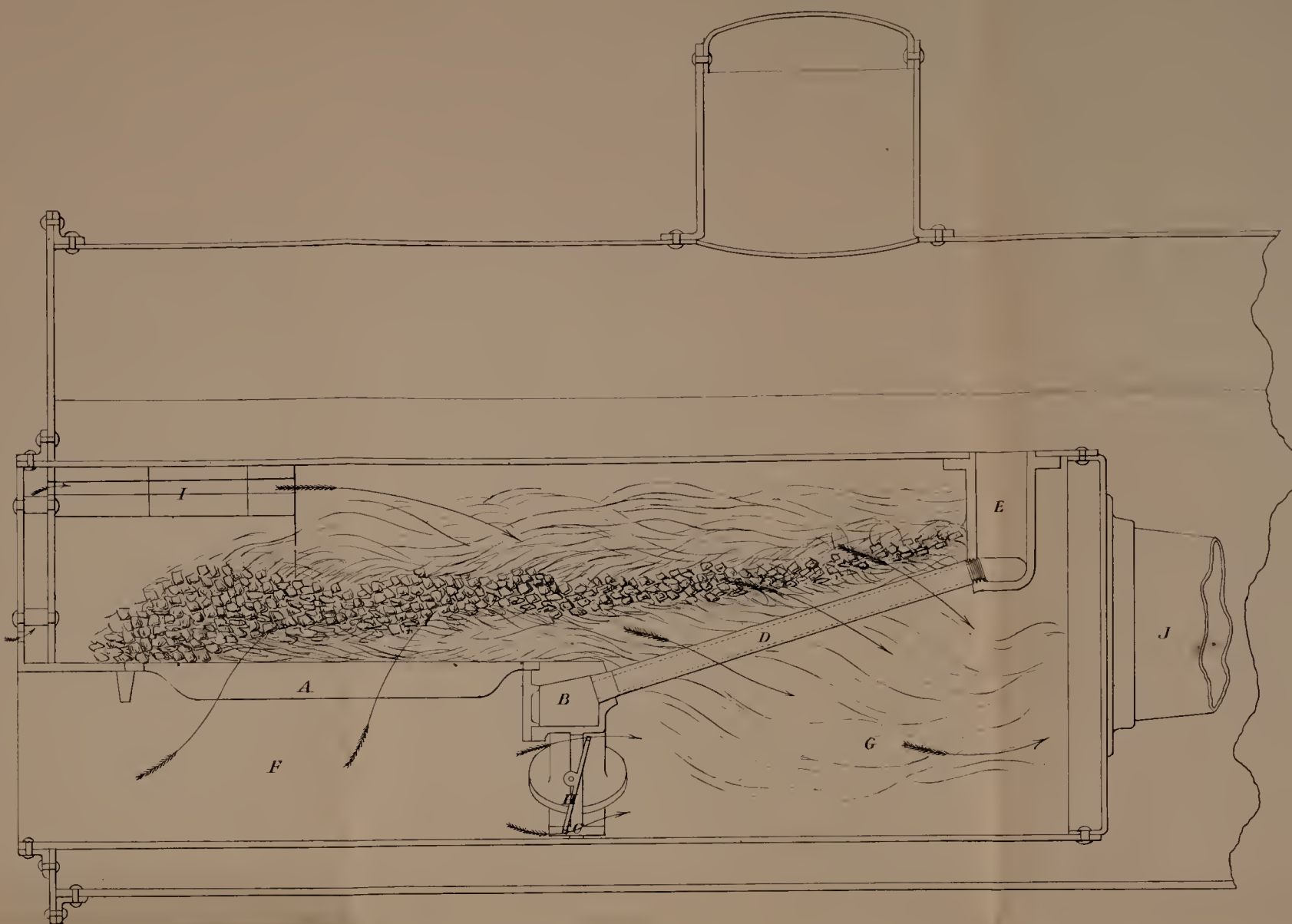


FIG. 7.



FIG. 6.



FIG. 3.

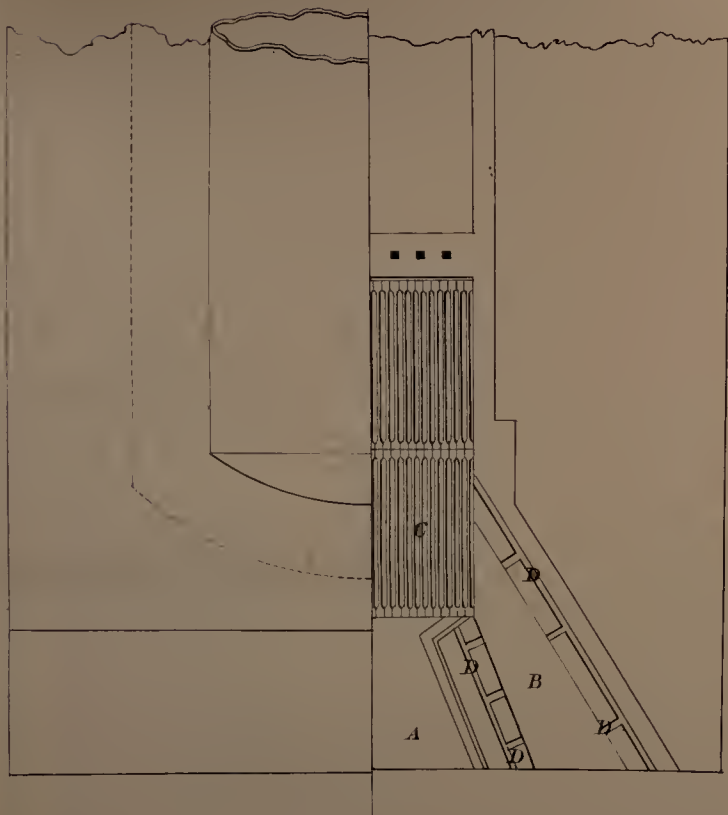


FIG. 4.

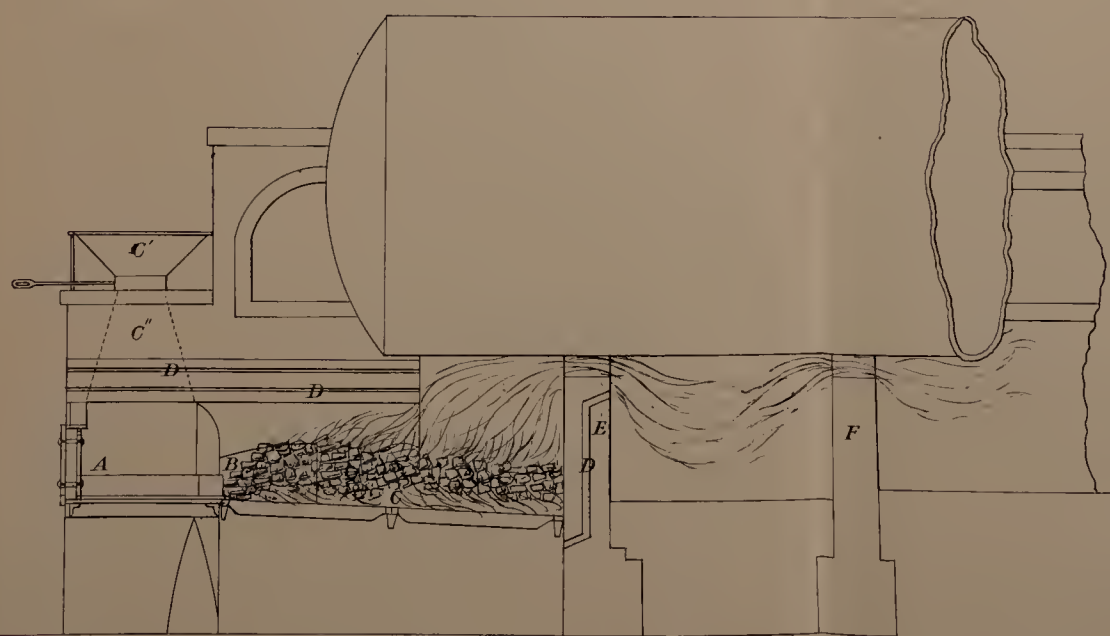


FIG. 5.

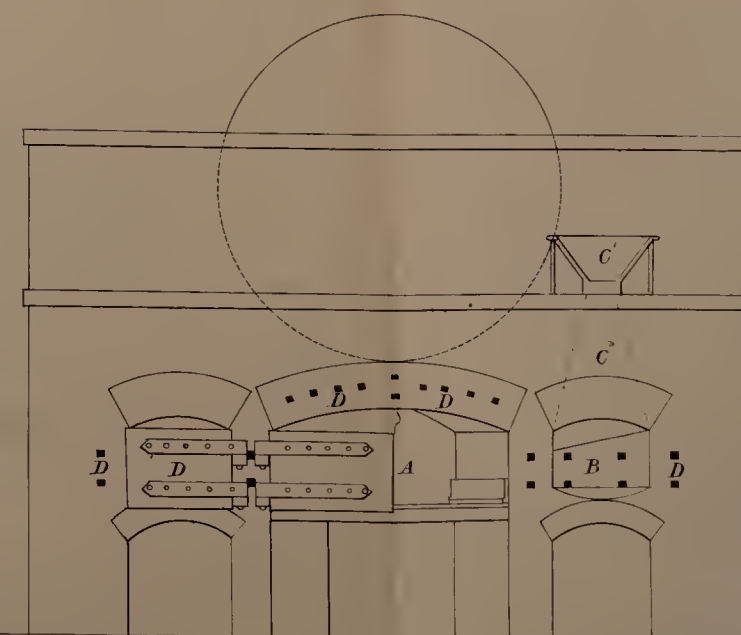


FIG. 1.

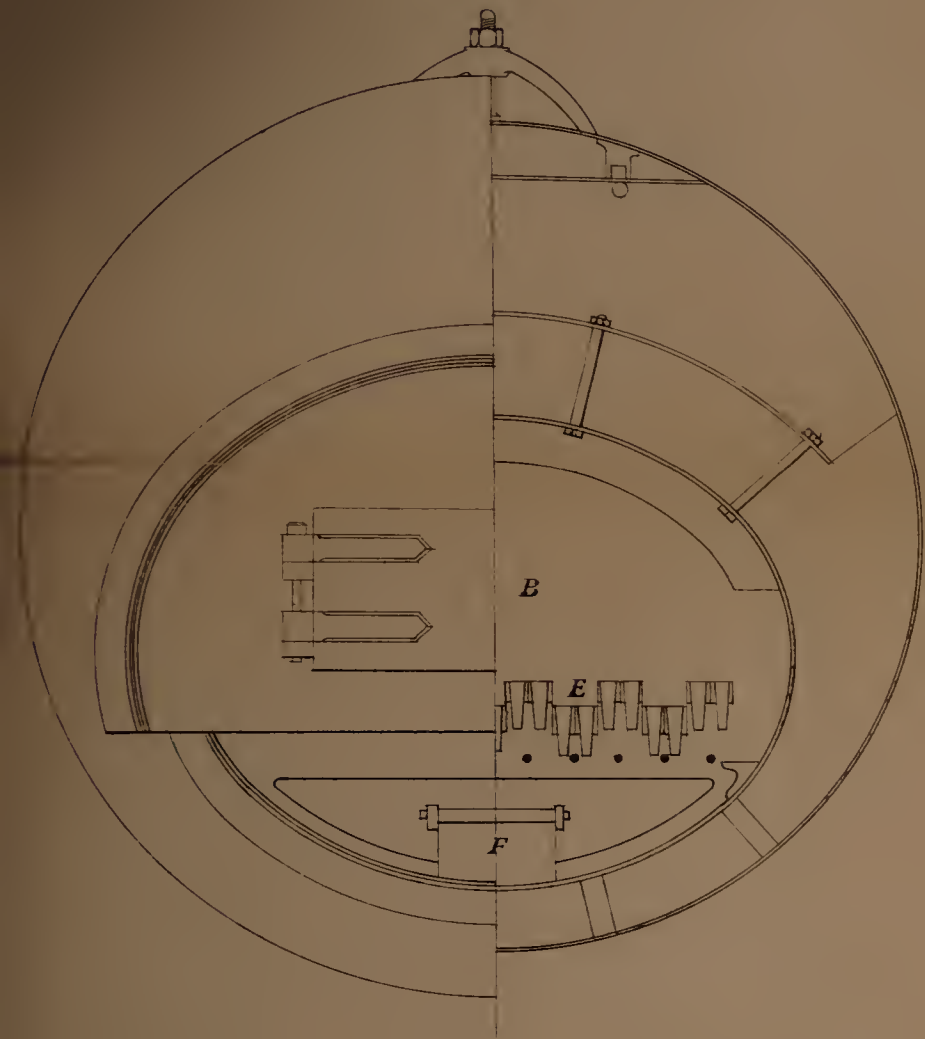


FIG. 2.

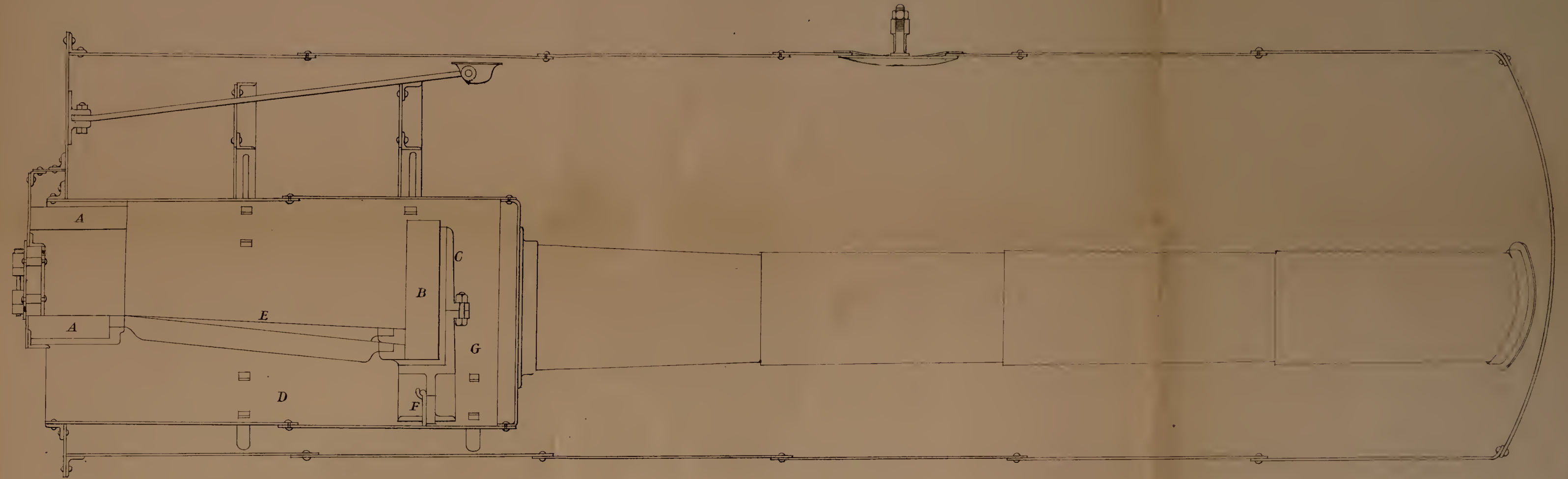
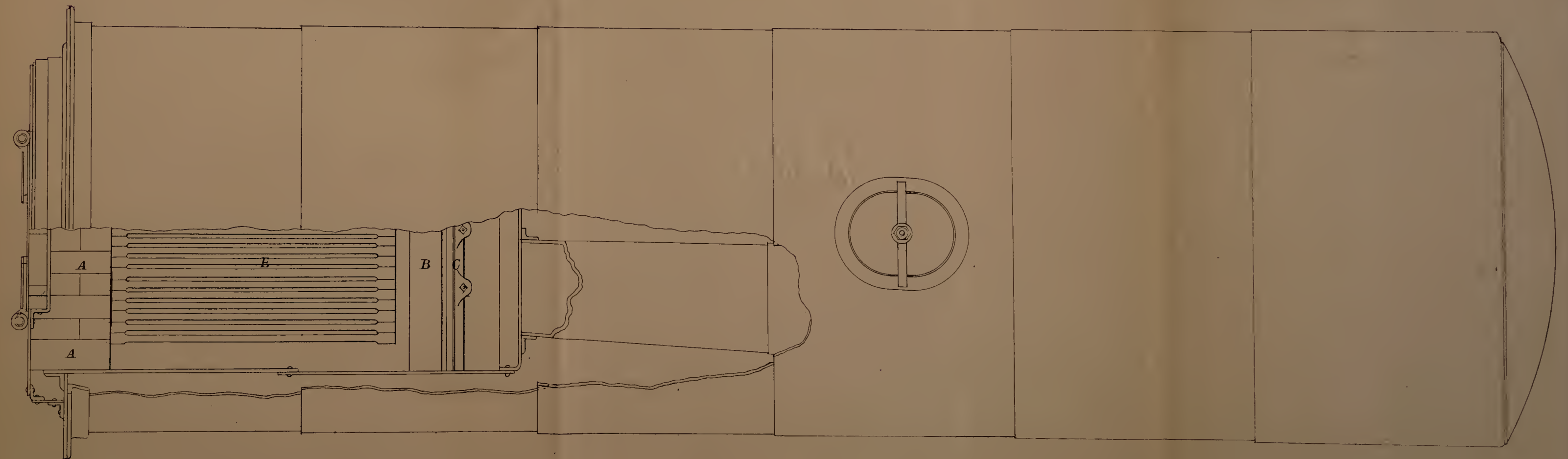
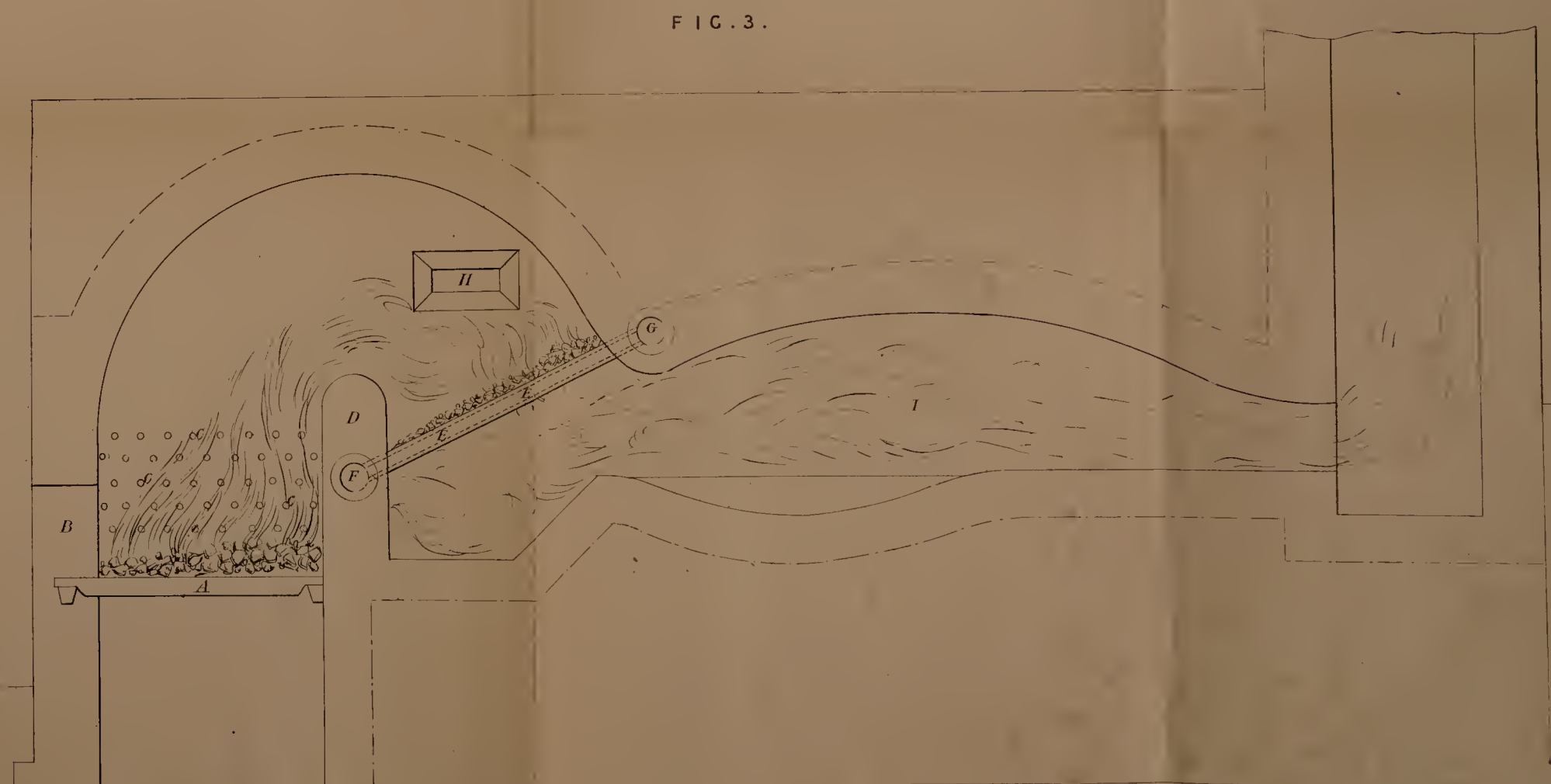
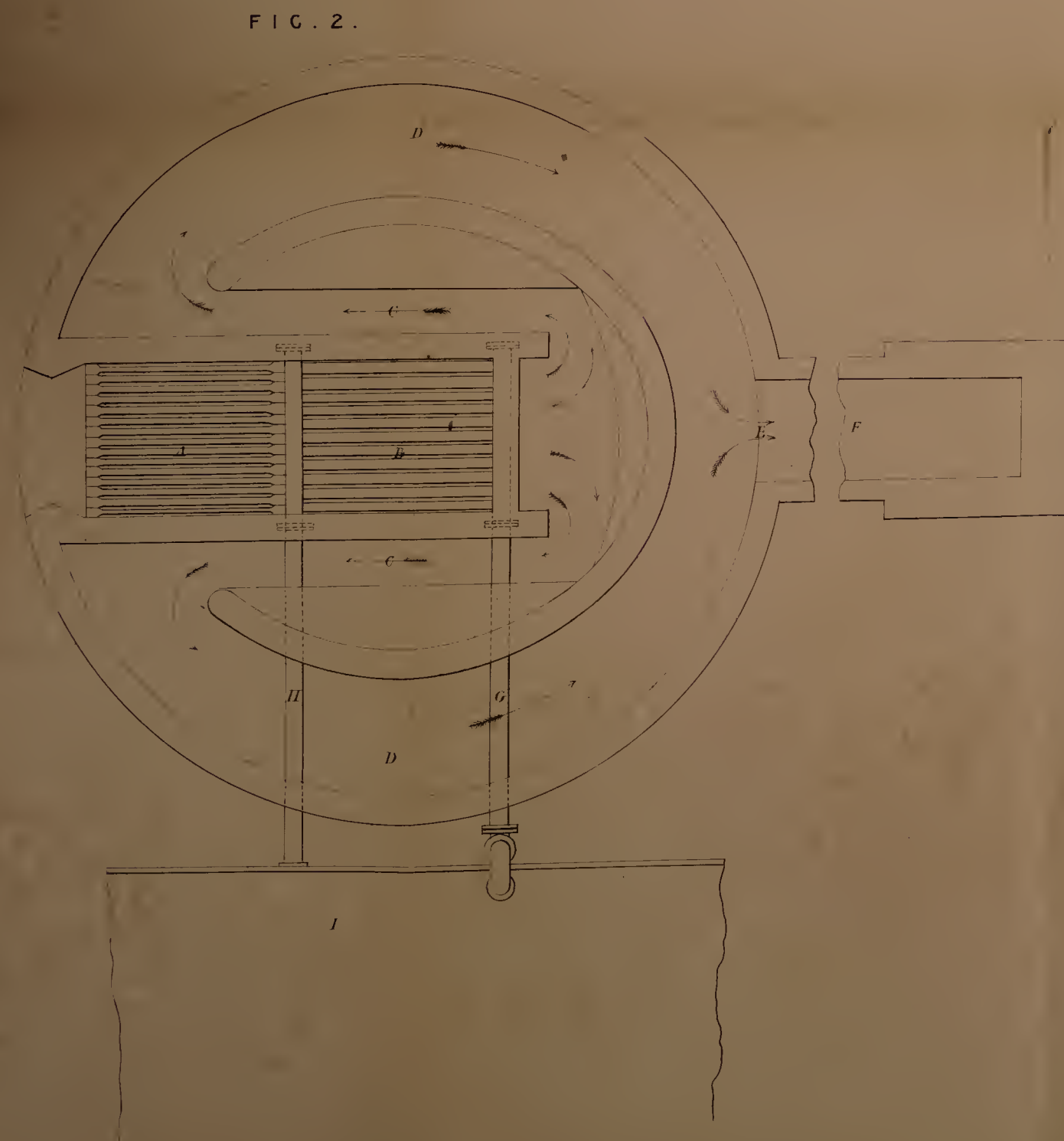
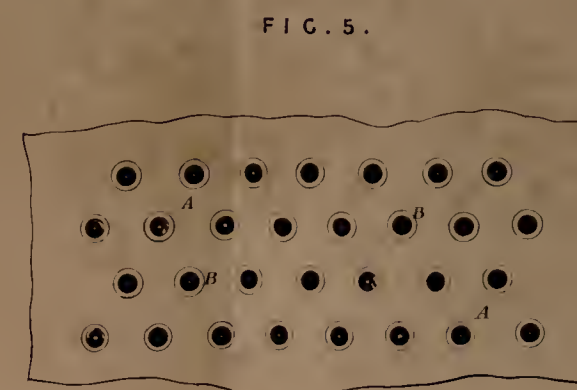
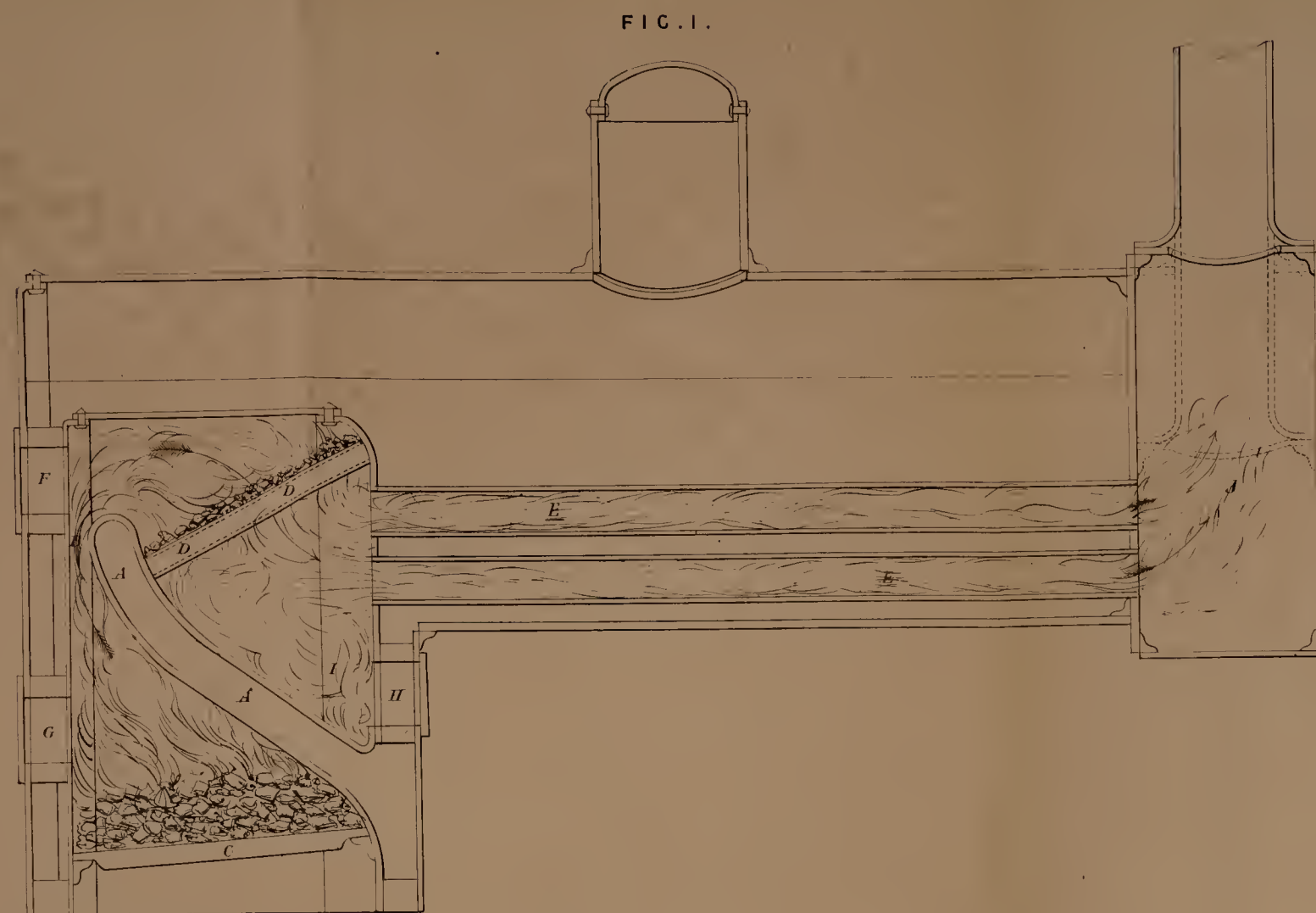
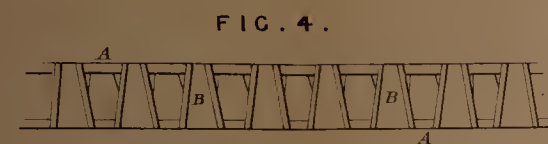


FIG. 3.





Dodds' Improvements in Furnaces and Fire-places, &c.

Having now described and particularly ascertained the nature of my said Invention, and the manner in which the same is or may be used or carried into effect, I would observe, in conclusion, that I do not confine or restrict myself to the precise details or arrangements which I have had occasion to
5 describe or refer to, as many variations may be made therefrom without deviating from the principles or main features of my said Invention; but what I consider to be novel and original, and therefore claim as the Invention secured to me by the herein-before in part recited Letters Patent, is,—

First, the general arrangement and construction of apparatus for effecting
10 a more perfect combustion of fuel and prevention of smoke, whether applied to steam boiler or other furnaces, or for the purposes of heating water generally, as herein-before described.

Second, the application and use of hollow bars or water passages, having water constantly circulating through them in auxiliary furnaces, wherein the
15 bituminous and carbonaceous vapour or unconsumed products of combustion are made to pass through the incandescent fuel contained therein, and between the auxiliary bars or water passages supporting such fuel.

Third, the herein-before described peculiar arrangement of coke ovens of any convenient form, and the application of the same to furnaces of all kinds,
20 either with or without auxiliary bars, for the purpose of coking the coal before being pushed on to the grate.

Fourth, the application and use of fire brick, fire stone, or fire clay, for the purpose of covering the surface of the dead plate and arch, to afford a better coking medium, as herein-before described.

25 Fifth, the admission of a current or currents of air in front of the bridge plate and behind the brickwork of the bridge; also at the mouth of the furnace, over the top and through the sides of the same, as herein-before described and illustrated in Sheet 2 of the Drawings.

30 In witness whereof, I, the said Thomas Weatherburn Dodds, hath hereunto set my hand and seal, the Twenty-third day of October, One thousand eight hundred and fifty-four.

T. W. DODDS. (L.S.)

LONDON :

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